3.0 STUDY METHODOLOGY

The area around the proposed Riverside MUPDD has been extensively studied since the year 2000 in connection with other developments proposed for the area. These studies have, however, primarily focused on the Riverhead traffic circle (the intersection of CR 63, CR 104, SR 24, CR 94, and Peconic Avenue), the intersection of NYS Route 24 (SR 24/Flanders Road) and County Road 105 (Cross River Drive), and the individual project driveway intersections with SR 24. This study will provide a comprehensive analysis of existing and future traffic conditions in the Riverside MUPDD area that is inclusive of these studies and supplemented with new data and analyses.

3.1 Summary of Study Methods

A detailed evaluation of traffic conditions, roadway characteristics, and intersectional characteristics within the Hamlet of Riverside was conducted during April and May of 2006. The primary and secondary roadway systems within the hamlet were examined and key intersections that would most likely be impacted by build-out conditions were identified. Turning movement counts for the weekday morning, mid-day, and evening peak traffic periods, as well as the Saturday mid-day peak traffic period, were also conducted during September of 2006. The evaluation involved the following:

1. Identifying the physical characteristics of the key intersections as well as the primary and secondary roadways within the hamlet. The inspections included obtaining data on operational aspects such as roadway widths, lane widths, parking regulations, speed limits, and signal timings.

2. Performing manual turning movement counts at the key intersections during the peak traffic periods. The intersections counted were:
   - NYS Route 24 & Old Quogue Road
   - NYS Route 24 & Ludlam Avenue
   - CR 104 & Old Quogue Road/Ludlam Avenue

3. Reviewing previous turning movement counts for the Rivercatwalk project, performed by RMS Engineering, P.C., in April of 2004 and for the Southampton Enterprise Zone project, performed by Dunn Engineering Associates, P.C., in September of 2002 at key intersections and updating them for the 2007 base year. This provides a continuum in the studies and allows existing conditions to be evaluated using equivalent traffic volume counts. The intersections included were:
   - Riverhead Traffic Circle
   - NYS Route 24 & CR 105 (Cross River Drive)

4. Establishing ambient traffic flow conditions for the 2012 Build year, including traffic flows generated by the proposed Rivercatwalk project.

5. Performing trip generation calculations for the various developmental components of the Riverside MUPDD project using the *Institute of Transportation Engineers (ITE) Trip Generation Manual (7th Ed.)* and determining how the trips are most likely to be distributed within the roadway network.

6. Performing capacity analysis calculations on the turning movement count data to determine the existing, future "No Build," and future "Build" operational Levels of Service (LOS) for each of the key intersections during each of the peak traffic periods.

7. Analyzing the results of the capacity analysis to establish the traffic flow conditions at each intersection.

8. Performing capacity analysis calculations and analyzing the results for each of the "Build" Alternatives proposed for the Riverside MUPDD project.

9. Proposing mitigation measures for intersections that receive poor capacity analysis results and assess the impacts of implementing these measures.

10. Researching and reviewing transit operations and emergency services provisions within the hamlet.

3.2 Capacity Analysis Methods

A measure of mobility and traffic flow is the operational level of service (LOS) at an intersection, a measure based on the intersection's traffic flow capacity. To determine the capacity and level of service at each intersection, methods for analyzing turning movement counts were employed in conformance with the procedures outlined in the *Highway Capacity Manual 2000 (HCM2000)*, published by the Transportation Research Board (TRB), a division of the U. S. Department of Transportation. The *Highway Capacity Manual 2000* operational method determines two key operating characteristics of signalized intersections: (1) the average stopped delay experienced per vehicle; and (2) the volume-to-capacity (v/c) ratio at the intersection, sometimes referred to as the *demand flow-to-capacity* ratio. These characteristics are based on the amount of traffic traveling through the intersection, the travel lane geometries, the percentage of heavy vehicles included in the traffic volumes and other factors affecting capacity such as the number of pedestrians, on-street parking, and bus operations near the intersection.

3.2.1 Capacity Analysis – Signalized and Un-Signalized Intersections

In accordance with policies established by the New York State Department of Transportation for acceptable methods of analyzing traffic on roads within the state, the Signalized Intersections Operational Analysis method from the *Highway Capacity Manual 2000* was employed to perform the intersectional level of service analysis for each of the signalized locations. The un-signalized key intersections were analyzed using stop-control methodologies described in the Un-signalized Intersections chapter of *HCM2000*. The two methodologies were used to evaluate the operational effectiveness of each intersection, which is described generally in terms of Level of Service (LOS). Definitions for Levels of Service are given in Table 3-1.

Table 3-1:

Intersection Level of Service Definitions (2000 Highway Capacity Manual)

LOS	DEFINITION
A	Represents free flow. Individual users are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to maneuver within the traffic stream is extremely high. The general level of comfort and convenience provided to the motorist, passenger, or pedestrian is excellent.
B	Represents stable flow, but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desire speeds is relatively unaffected, but there is a slight decline in the freedom to maneuver within the traffic stream from LOS A. The level of comfort and convenience provided is somewhat less than at LOS A, because the presence of others in the traffic stream begins to affect individual behavior.
C	Represents stable flow, but marks the beginning of the range of flow in which the operation of individual users becomes significantly affected by interactions with others in the traffic stream. The selection of speed is now affected by the presence of others, and maneuvering within the traffic stream requires substantial vigilance on the part of the user. The general level of comfort and convenience declines noticeably at this level.
D	Represents high-density, but stable, flow. Speed and freedom to maneuver are severely restricted, and the driver or pedestrian experiences a generally poor level of comfort and convenience. Small increases in traffic flow will generally cause operational problems at this level.
E	Represents operating conditions at or near the capacity level. All speeds are reduced to a low, but relatively uniform value. Freedom to maneuver within the traffic stream is extremely difficult, and it is generally accomplished by forcing a vehicle or pedestrian to "give way" to accommodate such maneuvers. Comfort and convenience levels are extremely poor, and driver or pedestrian frustration is generally high. Operations at this level are usually unstable, because even small increases in flow or minor perturbations within the traffic stream will cause breakdowns.
F	Represents forced or breakdown flow. This condition exists wherever the amount of traffic approaching a point exceeds the amount which can traverse it and queues begin to form. Operations within the queue are characterized by stopping and starting. Over and over, vehicles may progress at reasonable speeds for several hundred feet or more, and then be required to stop. LOS F is used to describe operating conditions within the queue, as well as the point of the breakdown. It should be noted, however, that in many cases once free of the queue, traffic may resume to normal conditions quite rapidly.

Levels of Service categories range from excellent, nearly free-flow traffic at LOS A, to overloaded, stop-and-go congested conditions at LOS F. Levels of Service and related delay terms are provided in Tables 3-2 and 3-3 for signalized intersections and un-signalized intersections, respectively. The LOS definitions and ranges of control delay shown in these tables represent average conditions for all vehicles at an intersection across an entire hour. Delays longer than the average condition may be experienced by motorists on certain movements or during peak times within the peak hour. Generally, LOS D is considered the minimum acceptable level of service, according to the latest edition of the *Highway Capacity Manual 2000*. In addition, the analysis will indicate a level of service for each permitted movement (left-thru-right) at an intersection.

Peak Hour Factor

The peak hour factor (PHF) is a measure of variability within a peak hour that accounts for volume differentiation that occurs during each fifteen (15) minute period within the hour. The PHF can be applied for the total of all approaches to an intersection, by directional approach to an intersection, or by individual movement at an intersection. For this study, PHF was applied by directional approach to each of the intersections analyzed, as recommended in the *HCM2000*.

Table 3-2:
Level of Service Standards for Signalized Intersections
(2000 Highway Capacity Manual Operational Method)

LEVEL OF SERVICE	AVERAGE TOTAL DELAY (seconds/vehicle)
A	≤ 10
B	> 10 and ≤ 20
C	> 20 and ≤ 35
D	> 35 and ≤ 55
E	> 55 and ≤ 80
F	> 80

Source: Transportation Research Board, *Highway Capacity Manual*, 2000.

Table 3-3:
Level of Service Standards for Unsignalized Intersections
(2000 Highway Capacity Stop-Control Method)

LEVEL OF SERVICE	AVERAGE TOTAL DELAY (seconds/vehicle)
A	≤ 10
B	> 10 and ≤ 15
C	> 15 and ≤ 25
D	> 25 and ≤ 35
E	> 35 and ≤ 50
F	> 50

Source: Transportation Research Board, *Highway Capacity Manual*, 2000.

3.2.2 Capacity Analysis – Roundabouts (Traffic Circles)

The *Highway Capacity Manual 2000* provides methods for analyzing the flow capacity of roundabouts, but the methods are limited to single-lane roundabouts with no more than four (4) approach legs. As the Riverhead Traffic Circle has five (5) approach legs, the methods prescribed in *HCM2000* and the tools provided in the related *Highway Capacity Software* were inappropriate for analyzing the roundabout. Improvements to the roundabout also include a proposal to increase its width and provide two (2) circulating travel lanes. For these reasons, an alternate program, *aaSidra*, created by Akcelik and Associates, was used to analyze the performance of the subject roundabout and other roundabouts proposed as potential mitigation measures for the Riverside MUPDD project.

The advantages of aaSidra as an analysis tool are that it has the ability to analyze roundabouts with more than four (4) approaches and more than one circulating travel lane. It also uses basic *HCM2000* methods to analyze traffic flow within a roundabout and applies these methods to multi-lane conditions with more than four (4) approaches. Additionally, the results are expressed in familiar control delay, volume-to-capacity (v/c) ratio, and level of service (LOS) terms that are used for analyzing signalized and un-signalized intersections. The results of the roundabout analyses can then be directly

compared to the results of capacity analyses performed for signalized and un-signalized intersections to determine the relative measures of effectiveness for implementing one type of traffic control over another. One other advantage of aaSidra is that it also produces the roundabout results of other analysis programs for the purpose of comparing results. Levels of Service and related delay terms are provided in Table 3-4 for roundabouts.

Table 3-4:
Level of Service Standards for Roundabouts
(2000 Highway Capacity & aaSidra Methods)

LEVEL OF SERVICE	AVERAGE TOTAL DELAY (seconds/vehicle)
A	≤ 10
B	> 10 and ≤ 15
C	> 15 and ≤ 25
D	> 25 and ≤ 35
E	> 35 and ≤ 50
F	> 50

Sources: Transportation Research Board, *Highway Capacity Manual*, 2000.
Akcelik & Associates Pty., Ltd., *aaSidra*.

3.3 Traffic Signal Warrant Analysis Methods

The installation of a traffic signal is suggested as a possible mitigation measure at several un-signalized intersection locations where capacity analysis identified poor operational levels of service resulting from the proposed "Build" action. For the purpose of determining whether a traffic signal is an appropriate traffic control device to remedy substandard traffic flow conditions, the Federal Highway Administration (FHWA), in Chapter 4 of its *Manual on Uniform Traffic Control Devices for Streets and Highways (2003 Ed.)*, has established eight (8) warrants, or criteria, that must be considered prior to installing a traffic signal. At least one of the warrants must be satisfied in order to install a traffic signal at an intersection. A ninth warrant, which is a combination of meeting several of the criteria at a slightly reduced level, is implied in the manual.

The Traffic Signal Warrants are:

Warrant 1 – Eight-Hour Vehicular Volume
Warrant 2 – Four-Hour Vehicular Volume
Warrant 3 – Peak Hour
Warrant 4 – Pedestrian Volume
Warrant 5 – School Crossing
Warrant 6 – Coordinated Signal System
Warrant 7 – Crash Experience
Warrant 8 – Roadway Network

Analysis of the subject un-signalized intersections was performed using the criteria specified for each of these warrants. Vehicular volumes from the turning movement counts collected were used for the peak traffic periods. For the off-peak periods when turning movement counts were not available, hourly vehicular volume counts collected by road-tube machines were used and proportionally adjusted to the peak period counts. Similarly, trip generation vehicular volumes for the peak periods were applied at a seventy-five percent (75%) rate for the off-peak periods.

The *FHWA Manual on Uniform Traffic Control Devices for Streets and Highways (2003 Ed.)* was used in the analysis rather than the *New York State Manual of Uniform Traffic Control Devices* because New York is replacing its manual and will adopt the FHWA manual as its own on September 13, 2007. As the Riverside MUPDD project will not be completed prior to this date, it is more appropriate to use the warranting requirements specified in the federal manual.

The federal manual cautions, however, that the satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal. It is intended solely as a tool for determining the appropriateness of a traffic signal at a location. Engineering considerations and other factors may be reasonably applied when making the determination.

Traffic Signal Warrant Specifications

1. Warrant 1 – Eight-Hour Vehicular Volume

Standard:

The need for a traffic control signal shall be considered if an engineering study finds that one of the following conditions exist for each of any 8 hours of an average day:

A. The vehicles per hour given in both of the 100 percent columns of Condition A in Table 3-5 exist on the major-street and the higher-volume minor-street approaches, respectively, to the intersection; or

B. The vehicles per hour given in both of the 100 percent columns of Condition B in Table 3-5 exist on the major-street and the higher-volume minor-street approaches, respectively, to the intersection.

In applying each condition the major-street and minor-street volumes shall be for the same 8 hours. On the minor street, the higher volume shall not be required to be on the same approach during each of these 8 hours.

Option:

If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 70 km/h or exceeds 40 mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, the traffic volumes in the 70 percent columns in Table 3-5 may be used in place of the 100 percent columns.

Table 3-5: Warrant 1 – Eight-Hour Vehicular Volume

Condition A—Minimum Vehicular Volume									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1.....	1.....	500	400	350	280	150	120	105	84
2 or more...	1.....	600	480	420	336	150	120	105	84
2 or more...	2 or more ...	600	480	420	336	200	160	140	112
1.....	2 or more	500	400	350	280	200	160	140	112

Condition B—Interruption of Continuous Traffic									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1.....	1.....	750	600	525	420	75	60	53	42
2 or more...	1.....	900	720	630	504	75	60	53	42
2 or more...	2 or more ...	900	720	630	504	100	80	70	56
1.....	2 or more	750	600	525	420	100	80	70	56

[a] Basic minimum hourly volume.
[b] Used for combination of Conditions A and B after adequate trial of other remedial measures.
[c] May be used when the major-street speed exceeds 70 km/h or exceeds 40 mph or in an isolated community with a population of less than 10,000.
[d] May be used for combination of Conditions A and B after adequate trial of other remedial measures when the major-street speed exceeds 70 km/h or exceeds 40 mph or in an isolated community with a population of less than 10,000.

2. Warrant 2 – Four-Hour Vehicular Volume

Standard:

The need for a traffic control signal shall be considered if an engineering study finds that, for each of any 4 hours of an average day, the plotted points representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the higher-volume minor-street approach (one direction only) all fall above the applicable curve in Figure 3-1 for the existing combination of approach lanes. On the

minor street, the higher volume shall not be required to be on the same approach during each of these 4 hours.

Option:
If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 70 km/h or exceeds 40 mph or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, Figure 3-2 may be used in place of Figure 3-1.

3. Warrant 3 – Peak Hour

Standard:
This signal warrant shall be applied only in unusual cases, such as office complexes, manufacturing plants, industrial complexes, or high-occupancy vehicle facilities that attract or discharge large numbers of vehicles over a short time.

The need for a traffic control signal shall be considered if an engineering study finds that the criteria in either of the following two categories are met:

A. If all three of the following conditions exist for the same 1 hour (any four consecutive 15-minute periods) of an average day:

1. The total stopped time delay experienced by the traffic on one minor-street approach (one direction only) controlled by a STOP sign equals or exceeds: 4 vehicle-hours for a one-lane approach; or 5 vehicle-hours for a two-lane approach, and

2. The volume on the same minor-street approach (one direction only) equals or exceeds 100 vehicles per hour for one moving lane of traffic or 150 vehicles per hour for two moving lanes, and

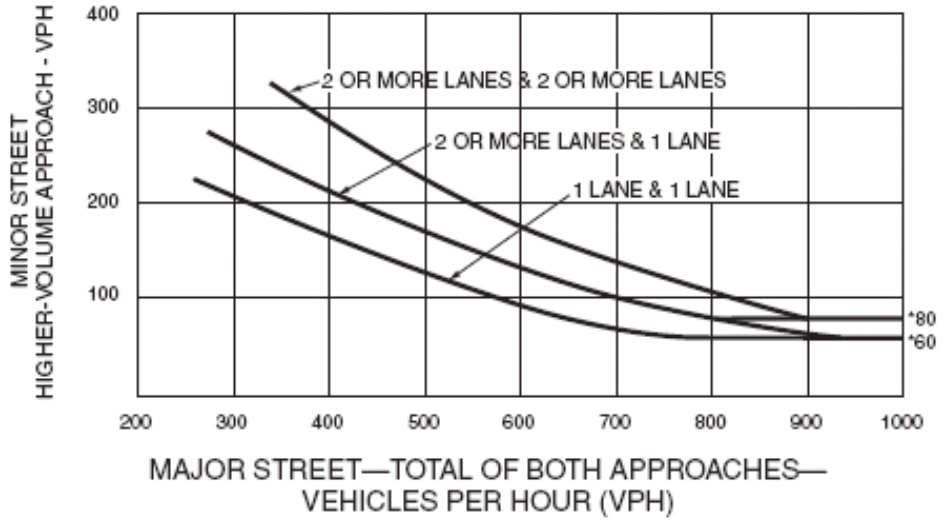
3. The total entering volume serviced during the hour equals or exceeds 650 vehicles per hour for intersections with three approaches or 800 vehicles per hour for intersections with four or more approaches.

Figure 3-1: Warrant 2 – Four-Hour Vehicular Volume

*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

Figure 3-2: Warrant 2 – Four-Hour Vehicular Volume (70% Factor)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 70 km/h OR ABOVE 40 mph ON MAJOR STREET)



*Note: 80 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 60 vph applies as the lower threshold volume for a minor-street approach with one lane.

B. The plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the higher-volume minor-street approach (one direction only) for 1 hour (any four consecutive 15-minute periods) of an average day falls above the applicable curve in Figure 3-3 for the existing combination of approach lanes.

Option:

If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 70 km/h or exceeds 40 mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, Figure 3-4 may be used in place of Figure 3-3 to satisfy the criteria in the second category of the Standard.

4. Warrant 4 – Pedestrian Volume

Standard:

The need for a traffic control signal at an intersection or mid-block crossing shall be considered if an engineering study finds that both of the following criteria are met:

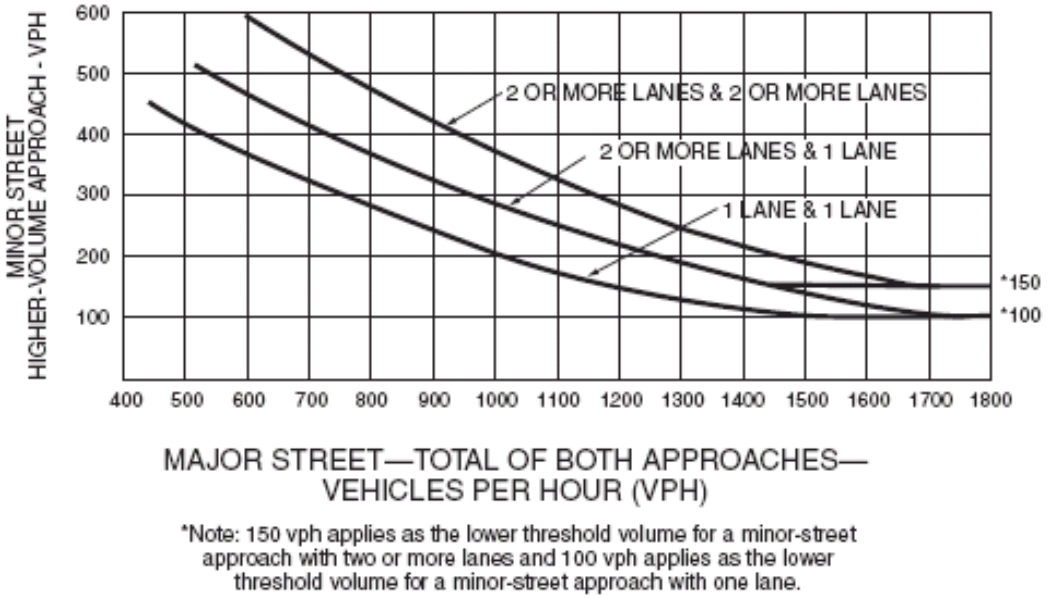
A. The pedestrian volume crossing the major street at an intersection or mid-block location during an average day is 100 or more for each of any 4 hours or 190 or more during any 1 hour; and

B. There are fewer than 60 gaps per hour in the traffic stream of adequate length to allow pedestrians to cross during the same period when the pedestrian volume criterion is satisfied. Where there is a divided street having a median of sufficient width for pedestrians to wait, the requirement applies separately to each direction of vehicular traffic.

The Pedestrian Volume signal warrant shall not be applied at locations where the distance to the nearest traffic control signal along the major street is less than 90 m (300 ft), unless the proposed traffic control signal will not restrict the progressive movement of traffic.

If this warrant is met and a traffic control signal is justified by an engineering study, the traffic control signal shall be equipped with pedestrian signal heads.

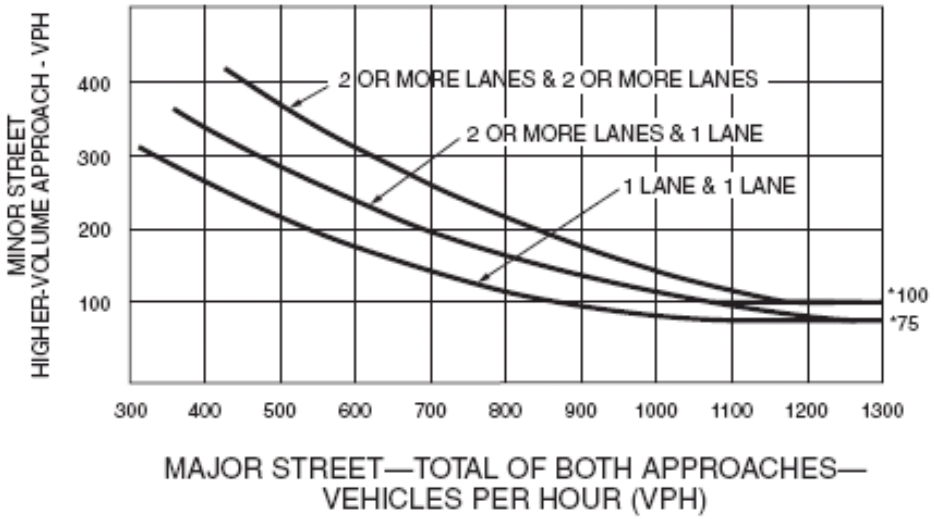
Figure 3-3: Warrant 3 – Peak Hour Volume



*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Figure 3-4: Warrant 3 – Peak Hour Volume (70% Factor)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 70 km/h OR ABOVE 40 mph ON MAJOR STREET)



*Note: 100 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor-street approach with one lane.

Option:

The criterion for the pedestrian volume crossing the major roadway may be reduced as much as 50 percent if the average crossing speed of pedestrians is less than 1.2 m/sec (4 ft/sec). A traffic control signal may not be needed at the study location if adjacent coordinated traffic control signals consistently provide gaps of adequate length for pedestrians to cross the street, even if the rate of gap occurrence is less than one per minute.

5. Warrant 5 – School Crossing

Standard:

The need for a traffic control signal shall be considered when an engineering study of the frequency and adequacy of gaps in the vehicular traffic stream as related to the number and size of groups of school children at an established school crossing across the major street shows that the number of adequate gaps in the traffic stream during the period when the children are using the crossing is less than the number of minutes in the same period and there are a minimum of 20 students during the highest crossing hour.

Before a decision is made to install a traffic control signal, consideration shall be given to the implementation of other remedial measures, such as warning signs and flashers, school speed zones, school crossing guards, or a grade-separated crossing.

The School Crossing signal warrant shall not be applied at locations where the distance to the nearest traffic control signal along the major street is less than 90 m (300 ft), unless the proposed traffic control signal will not restrict the progressive movement of traffic.

6. Warrant 6 – Coordinated Signal System

Standard:

The need for a traffic control signal shall be considered if an engineering study finds that one of the following criteria is met:

A. On a one-way street or a street that has traffic predominantly in one direction, the adjacent traffic control signals are so far apart that they do not provide the necessary degree of vehicular platooning.

B. On a two-way street, adjacent traffic control signals do not provide the necessary degree of platooning and the proposed and adjacent traffic control signals will collectively provide a progressive operation.

7. Warrant 7 – Crash Experience

Standard:

The need for a traffic control signal shall be considered if an engineering study finds that all of the following criteria are met:

A. Adequate trial of alternatives with satisfactory observance and enforcement has failed to reduce the crash frequency; and

B. Five or more reported crashes, of types susceptible to correction by a traffic control signal, have occurred within a 12-month period, each crash involving personal injury or property damage apparently exceeding the applicable requirements for a reportable crash; and

C. For each of any 8 hours of an average day, the vehicles per hour (vph) given in both of the 80 percent columns of Condition A in Table 3-5, or the vph in both of the 80 percent columns of Condition B in Table 3-5 exists on the major-street and the higher-volume minor-street approach, respectively, to the intersection, or the volume of pedestrian traffic is not less than 80 percent of the requirements specified in the Pedestrian Volume warrant. These major-street and minor-street volumes shall be for the same 8 hours. On the minor street, the higher volume shall not be required to be on the same approach during each of the 8 hours.

Option:

If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 70 km/h or exceeds 40 mph, or if the intersection lies within the built-up area of

an isolated community having a population of less than 10,000, the traffic volumes in the 56 percent columns in Table 3-5 may be used in place of the 80 percent columns.

8. Warrant 8 – Roadway Network

Standard:

The need for a traffic control signal shall be considered if an engineering study finds that the common intersection of two or more major routes meets one or both of the following criteria:

A. The intersection has a total existing, or immediately projected, entering volume of at least 1,000 vehicles per hour during the peak hour of a typical weekday and has 5-year projected traffic volumes, based on an engineering study, that meet one or more of Warrants 1, 2, and 3 during an average weekday; or

B. The intersection has a total existing or immediately projected entering volume of at least 1,000 vehicles per hour for each of any 5 hours of a non-normal business day (Saturday or Sunday).

A major route as used in this signal warrant shall have one or more of the following characteristics:

A. It is part of the street or highway system that serves as the principal roadway network for through traffic flow; or

B. It includes rural or suburban highways outside, entering, or traversing a City; or

C. It appears as a major route on an official plan, such as a major street plan in an urban area traffic and transportation study.